

MEDICAL PLASTICS



PLS009G
March 2015

Melvin Schlechter
Project Analyst

ISBN: 1-62296-072-6



BCC Research
49 Walnut Park, Building 2
Wellesley, MA 02481 USA
866-285-7215 (toll-free within the USA),
or (+1) 781-489-7301
www.bccresearch.com
information@bccresearch.com

TABLE OF CONTENTS

TOPIC	PAGE NO.
CHAPTER 1 INTRODUCTION	2
STUDY GOALS AND OBJECTIVES	2
REASONS FOR DOING STUDY	2
SCOPE OF REPORT	2
METHODOLOGY	3
INTENDED AUDIENCE	3
ANALYST'S CREDENTIALS	3
RELATED BCC REPORTS	3
BCC RESEARCH WEBSITE	4
DISCLAIMER	4
CHAPTER 2 SUMMARY	6
<i>SUMMARY TABLE U.S. MEDICAL PLASTICS MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	6
<i>SUMMARY FIGURE U.S. MEDICAL PLASTICS MARKET BY RESIN, 2014-2020 (MILLION POUNDS)</i>	6
CHAPTER 3 HEALTHCARE INDUSTRY	10
BACKGROUND	10
CONSUMER CHARACTERISTICS AND FACTORS AFFECTING DEMAND	11
HOME HEALTHCARE	12
HOSPITAL PRODUCTS/MEDICAL SUPPLIES	12
MARKETING ASPECTS OF THE HEALTHCARE INDUSTRY	13
OVERVIEW	13
LARGE PURCHASING/MARKETING GROUPS CHANGING THE FACE OF MEDICAL DEVICE MARKETING	13
OFFSHORE COMPETITION	14
CONTRACT MANUFACTURING	14
Background	14
The Decision Variables for Contract Manufacturing	15
Choosing a Contract Manufacturer	15
OFFSHORE OUTSOURCING	16
CHANGING DEMOGRAPHICS AND LIFESTYLES	16
HEALTHCARE COST CONTAINMENT	17
OVERVIEW	17
MANAGED CARE	17
SHIFTS IN PLASTIC USAGE	18
STATUS OF THE HEALTHCARE INDUSTRY	18
CHAPTER 4 MEDICAL DEVICES	20
OVERVIEW	20
OVERALL PLASTIC USAGE	20
BACKGROUND	20
OVERALL STRUCTURE OF THE MEDICAL DEVICE INDUSTRY	21
<i>TABLE 1 U.S. MEDICAL INDUSTRY: PRINCIPAL MATERIALS, PRODUCER TYPES, MAJOR PRODUCTS AND PRINCIPAL CONSUMERS</i>	21

TOPIC	PAGE NO.
MAJOR MEDICAL DEVICE COMPANIES	21
<i>TABLE 2 CURRENT LEADING U.S. MEDICAL DEVICES COMPANIES, 2013 (\$ MILLIONS)</i>	21
POLYMERS USED	22
BACKGROUND	22
OVERVIEW	22
COMMODITY THERMOPLASTICS	23
ENGINEERING RESINS	23
THERMOSET RESINS	23
OVERALL RESIN USAGE IN MEDICAL DEVICES	23
<i>TABLE 3 SELECTED RESIN USAGE BY TYPE OF MEDICAL DEVICE</i>	24
NEW DEVELOPMENTS	25
ADVANCES IN DRUG-DELIVERY DEVICES	25
MEDICAL DEVICE INNOVATIONS ARE CHANGING	25
STILL A HEALTHY FINANCIAL MARKET	25
OBAMA CARE IMPACT	25
CHAPTER 5 LEGISLATIVE AND REGULATORY ISSUES	28
OVERVIEW	28
BACKGROUND	28
PLASTICS TESTING PROCEDURES	29
BIOCOMPATIBILITY ISSUES	30
OVERVIEW	30
SCOPE	30
RECENT DEVELOPMENTS	30
MEDICAL DEVICE TAX ISSUES	30
FDA IS EXAMINING REGULATIONS FOR 3-D PRINTED MEDICAL DEVICES	31
FDA PLANS TO EXPEDITE MEDICAL DEVICE APPROVALS	31
FDA IS PLANNING TO SIMPLIFY MEDICAL DEVICE CLASSIFICATION PROCEDURES	31
MEDICAL DEVICE CYBER SECURITY	32
CHAPTER 6 ENVIRONMENTAL ISSUES	34
BACKGROUND	34
SPECTER OF MEDICAL WASTE	34
SOURCE REDUCTION	35
RECYCLING	35
SOLID WASTE DISPOSAL	35
ROLE OF MEDICAL DEVICE COMPANIES	36
CHAPTER 7 RECENT PATENTS RELATED TO MEDICAL DEVICES	38
POLYISOBUTYLENE, UREA AND URETHANE/UREA COPOLYMERS AND MEDICAL LEADS	38
MEDICAL DEVICES AND MATERIALS CONTAINING ISOBUTYLENE POLYMER	38
SIDE-CHAIN CRYSTALLIZABLE POLYMERS FOR MEDICAL APPLICATION	38
MEDICAL POLYMERS CONTAINING RADIATION RESISTANT POLYMERS	38
COATINGS FOR MANUFACTURE AND APPLICATION OF POLYHYDROXY-ALKANOATE MEDICAL DEVICES	38

TOPIC	PAGE NO.
LOW FRICTION POLYMERIC COMPOSITIONS AS WELL AS DEVICES AND DEVICE FABRICATION METHODS	39
THERMAL RESPONSIVE POLYMER SILOXANES, COMPOSITIONS AND METHODS AND APPLICATIONS	39
MODIFIED HYALURONIC ACID POLYMER COMPOSITIONS	39
METHOD OF MANUFACTURING ANTIMICROBIAL IMPLANTS OF POLYETHERETHER KETONES	39
MONO ETHYLENICALLY UNSATURATED POLYMERIZABLE GROUP CONTAINING POLYCARBOSILOXANE MOMOMERS	40
COPOLYMERS AND DIHYDROXYPHENYL MOIETIES AND MEDICAL DEVICES COATED WITH COPOLYMERS	40
METHODS FOR MAKING OXIDATION RESISTANT POLYMERIC MATERIAL	40
MEDICAL DEVICES AND COATINGS COMPRISING BIODEGRADABLE POLYMERS WITH ENHANCED FUNCTIONALITY	40
POLYMERIC MATERIALS FOR MEDICAL DEVICES	40
CHAPTER 8 MEDICAL DEVICE PLASTIC PROCESSES	42
INJECTION MOLDING	42
BACKGROUND	42
DETAILS	42
EXTRUSION	42
BACKGROUND	42
SINGLE- AND TWIN-SCREW EXTRUSION	43
EXTRUSION AND MELT FILM FABRICATION	43
BLOWN FILMS	43
FILM CASTING	44
SOLVENT CASTING	44
BLOW MOLDING	44
OVERVIEW	44
EXTRUSION BLOW MOLDING	45
INJECTION BLOW MOLDING	45
STRETCH BLOW MOLDING	45
THERMOFORMING	46
HISTORY	46
OVERVIEW	46
APPLICATIONS	46
CHAPTER 9 STERILIZATION TECHNIQUES	48
OVERVIEW OF METHODS	48
ETHYLENE OXIDE GAS STERILIZATION	48
RADIATION STERILIZATION	48
GAMMA RADIATION	49
E-BEAM RADIATION	49
VAPORIZED HYDROGEN PEROXIDE	49
DRY-HEAT STERILIZATION	49
GAMMA RADIATION VS. ETO	50
THE MOVE TO GLOBAL STERILIZATION STANDARDS	50
POLYMER REACTIONS TO STERILIZATION METHODS	50
BACKGROUND	50

TOPIC	PAGE NO.
PVC	51
POLYPROPYLENE	51
POLYETHYLENE	51
ABS AND SAN	51
POLYCARBONATE	51
POLYSTYRENE	51
POLYESTERS	52
RADIATION RESISTANCE	52
<i>TABLE 4 RADIATION RESISTANCE OF KEY MEDICAL PLASTICS</i>	53
CHAPTER 10 VALIDATION TESTS FOR MEDICAL PLASTICS	55
BACKGROUND	55
RATINGS AND TESTS	55
<i>TABLE 5 SELECTED TESTS FOR PLASTICS USED IN MEDICAL APPLICATIONS</i>	56
SELECTED STERILIZATION STANDARDS FOR MEDICAL DEVICES	56
<i>TABLE 6 SELECTED/RANDOM EXAMPLES OF STERILIZATION STANDARDS FOR MEDICAL DEVICES</i>	56
CHAPTER 11 APPLICATIONS	59
BACKGROUND	59
POINT-OF-CARE TESTING	59
INFUSION DRUG DELIVERY THERAPY	59
OTHER APPLICATIONS	59
WASTE REDUCTION	60
STERILIZATION AND BIOCOMPATIBILITY	60
MEDICAL DEVICE CATEGORY CRITERIA	60
ECONOMIC ASPECTS AND OUTLOOK	61
APPLICATION MARKET ESTIMATES AND FORECASTS	62
<i>TABLE 7 U.S. MEDICAL PLASTICS MARKET BY OVERALL APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	62
NONDISPOSABLES	62
OVERVIEW	62
MARKET ESTIMATES AND FORECASTS	63
<i>TABLE 8 U.S. NONDISPOSABLE MEDICAL PLASTIC MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	63
SURGICAL INSTRUMENTS	63
Overview	63
Specific Products	64
Technical Requirements	64
Materials Used	64
Sutures	65
Other Surgery-Related Plastic Medical Devices	66
Blood Centrifuge Bowls	66
Blood Oxygenators	66
Cardiopulmonary Supplies	66
Trocars	67
Surgical Procedures Will Affect Medical Devices and Eventually Resin Selection	67

TOPIC	PAGE NO.
Examples of Plastic Surgical Instruments	67
Manufacturers of Surgical Instruments	67
<i>TABLE 9 SELECTED KEY MANUFACTURERS OF SURGICAL INSTRUMENTS</i>	68
Market Estimates and Forecasts	68
<i>TABLE 10 U.S. SURGICAL INSTRUMENT/RELATED EQUIPMENT MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	69
<i>TABLE 11 U.S. COMMODITY THERMOPLASTIC SURGICAL INSTRUMENTS/RELATED EQUIPMENT MARKET, THROUGH 2020 (MILLION POUNDS)</i>	69
<i>TABLE 12 U.S. STYRENIC RESIN SURGICAL INSTRUMENTS/RELATED EQUIPMENT MARKET, THROUGH 2020 (MILLION POUNDS)</i>	69
<i>TABLE 13 U.S. MARKET IN OTHER RESINS IN SURGICAL INSTRUMENTS/RELATED EQUIPMENT, THROUGH 2020 (MILLION POUNDS)</i>	70
TESTING AND DIAGNOSTIC EQUIPMENT	70
Overview	70
Diagnostic Equipment	70
Examples of Diagnostic/Testing Equipment	71
The Medical Testing Business	71
Key Medical Testing and Diagnostic Companies	71
<i>TABLE 14 KEY SELECTED MEDICAL TESTING AND DIAGNOSTIC COMPANIES</i>	71
Electromedical Equipment	72
Clinical Laboratory Equipment	72
Polymers Used	72
Overview	72
Specific Examples	73
Market Estimates and Forecasts	73
<i>TABLE 15 U.S. TESTING/DIAGNOSTIC EQUIPMENT MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	73
<i>TABLE 16 U.S. COMMODITY THERMOPLASTIC TESTING/DIAGNOSTIC EQUIPMENT MARKET, THROUGH 2020 (MILLION POUNDS)</i>	74
<i>TABLE 17 U.S. STYRENIC RESIN TESTING/DIAGNOSTIC EQUIPMENT MARKET, THROUGH 2020 (MILLION POUNDS)</i>	74
<i>TABLE 18 U.S. MARKET IN OTHER RESINS IN TESTING/DIAGNOSTIC EQUIPMENT, THROUGH 2020 (MILLION POUNDS)</i>	75
IMPLANTS AND PROSTHETIC DEVICES	75
Background	75
Overview	75
Scope	75
Thermoplastic Materials Used	76
Overview	76
Use of Ultra-High Molecular Weight Polyethylene (UHMWPE)	76
Organ Replacements	76
Implanted and Ingested Drug Delivery Systems	77
EXAMPLES OF PROSTHESES AND IMPLANT CATEGORIES USING PLASTICS	78
New Plastic Developments Related to Artificial Limbs	78
An Example of a Plastic Supplier's Prosthetic Products	78
New Developments	79
Progress with Plastic Limbs	79
Fully Fluorinated LSRs Used for Medical Implants	79

TOPIC	PAGE NO.
The Overall Use of Plastics in Medical Implants is Growing Rapidly	79
Market Estimates and Forecasts	79
<i>TABLE 19 U.S. PROSTHESES/IMPLANTS MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	80
<i>TABLE 20 U.S. COMMODITY THERMOPLASTIC PROSTHESES/IMPLANTS MARKET, THROUGH 2020 (MILLION POUNDS)</i>	80
<i>TABLE 21 U.S. MARKET IN OTHER RESINS USED IN PROSTHESES/IMPLANTS, THROUGH 2020 (MILLION POUNDS)</i>	80
DENTAL AND OPHTHALMIC PRODUCTS	81
Overview	81
Polymers Used	81
Plastic Lenses	82
Contact Lenses	83
Dental Restorative Materials	83
Amalgams	83
Composite Resins	83
Glass Ionomer Cement	83
Dentures	84
Market Estimates and Forecasts	84
<i>TABLE 22 U.S. DENTAL/OPHTHALMIC MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	84
<i>TABLE 23 SPECIFIC RESIN USAGE IN U.S. DENTAL/OPHTHALMIC MARKET, THROUGH 2020 (MILLION POUNDS)</i>	84
DISPOSABLE MEDICAL DEVICES	85
OVERVIEW	85
MEDICAL DISPOSAL CONTROVERSY	85
MARKET ESTIMATES AND FORECASTS	86
<i>TABLE 24 U.S. DISPOSABLE MEDICAL PLASTIC MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	86
MEDICAL BAGS	86
Background	86
Intravenous Solution Bags	86
Fluid Administration Systems (Including Collection Bags)	87
Background	87
Related Products	87
Enema Bags	87
Blood Bags	88
Pouches and Other Applications	88
Alternatives to PVC in Medical Bags	89
Overview	89
Viable PVC Replacement Materials	89
Medical Bags Manufacturers	90
<i>TABLE 25 SELECTED KEY MEDICAL BAG MANUFACTURERS</i>	90
Medical Bags Manufacturers	90
<i>TABLE 25 SELECTED KEY MEDICAL BAG MANUFACTURERS</i>	90
Market Estimates and Forecasts	91
<i>TABLE 26 U.S. MEDICAL BAG MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	91
SYRINGES	91

TOPIC	PAGE NO.
Background	91
Products and Applications	92
Syringe Alternatives	92
Syringe Innovations	93
Prefilled Syringe Historical Aspects	94
Polymer Usage	94
Safety Syringes	95
Self-Administration Becomes a Major Issue	95
Warnings against Reuse of Plastic Syringes	95
No Needles	96
Needlestick Prevention Needs a Safe Design	96
An Interesting Observation	96
Major Syringe Manufacturers	96
<i>TABLE 27 OTHER SELECTED SYRINGE MANUFACTURERS</i>	97
Market Estimates and Forecasts	97
<i>TABLE 28 U.S. SYRINGES MARKET BY RESIN THROUGH 2020 (MILLION POUNDS)</i>	97
LABWARE	98
Background	98
Resins Used	98
<i>TABLE 29 EXAMPLES OF DISPOSABLE MEDICAL PLASTIC LABWARE</i>	98
<i>TABLE 30 SELECTED PLASTIC MEDICAL LABWARE SUPPLIERS</i>	99
Market Estimates and Forecasts	99
<i>TABLE 31 U.S. MEDICAL LABWARE MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	100
CATHETERS	100
Background	100
Manufacturing a Foley Catheter	101
Property Criteria	101
<i>TABLE 32 RESIN PROPERTY CRITERIA-CATHETERS</i>	102
Cardiac Usage	102
Demand for Plastics	103
Materials	103
Intravenous Products	103
Catheter Trends	104
Overview	104
Smaller and Smaller Catheters	104
Shifts in Plastic Usage	104
Catheter Manufacturers	104
<i>TABLE 33 SELECTED KEY CATHETER MANUFACTURERS</i>	105
Market Estimates and Forecasts	105
<i>TABLE 34 U.S. CATHETER/IV UNIT MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	105
New Developments	106
Extrusion Eliminates Assembly of Medical Catheter Shafts	106
Hydrophilic Elastomer Catheters	106
Catheters can be both Translucent and Radiopaque	106
Adhesives for New Catheters	106
KITS	106

TOPIC	PAGE NO.
Overview	106
Performance Criteria	107
<i>TABLE 35 MATERIAL PROPERTY CRITERIA- KITS</i>	108
Surgical Kits	108
Market Estimates and Forecasts	108
<i>TABLE 36 U.S. KITS MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	109
TUBING	109
Products and Applications	109
Stainless Steel Medical Tubing Increasing	109
Plastic Medical Tubing Niches	110
Properties	110
Resin Components and Requirements	110
PVC Usage	111
Features of Medical Tubing	111
<i>TABLE 37 COMMON FEATURES OF SELECTED APPLICATIONS FOR PRIMARY RESINS USED IN MEDICAL TUBING</i>	111
Applications	112
<i>TABLE 38 SAMPLE APPLICATIONS FOR FLEXIBLE MEDICAL TUBING BY MAJOR CATEGORY</i>	112
Medical Tubing Stretches Processing Technology	113
Current Status of PVC Replacement	113
Multilayer Tubing	114
Material Advancements	114
Selected Plastic Medical Tubing Extruders	114
<i>TABLE 39 SELECTED PLASTIC MEDICAL TUBING EXTRUDERS</i>	115
Market Estimates and Forecasts	115
<i>TABLE 40 U.S. TUBING MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	115
Recent Developments	116
It Is Still Difficult to Replace PVC in Medical Tubing	116
A Medical Tubing Extruder Offers SBC as PVC Replacement	116
Fluoropolymers, Nylon and TPEs as Possible PVC Replacements	116
GLOVES	116
Background	116
Medical Gloves	117
Glove Protection Standards	117
Polymers Used	117
Latex Allergy Issue	117
Alternatives to Latex Rubber for Gloves	118
Medical Gloves Manufacturers	118
<i>TABLE 41 SELECTED KEY MEDICAL GLOVE MANUFACTURERS AND MAJOR PRODUCTS</i>	118
Market Estimates and Forecasts	119
<i>TABLE 42 U.S. MEDICAL GLOVE MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	119
UTENSILS	120
Background	120
Market Estimates and Forecasts	120

TOPIC	PAGE NO.
<i>TABLE 43 U.S. MEDICAL UTENSIL MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	120
TRAYS	121
Overview	121
Background	121
Types of Medical Trays	121
Sterilization	121
Thermoform or Injection Mold?	121
<i>TABLE 44 RESIN PROPERTY CRITERIA-TRAYS</i>	122
Property Parameters for Choosing Tray Materials	122
Tray Designs for Different Environments	123
Sterilization	123
Polypropylene Usage	123
HIPS Involvement	124
Medical Tray Manufacturers	124
<i>TABLE 45 SELECTED PLASTIC MEDICAL TRAY MANUFACTURERS</i>	124
Market Estimates and Forecasts	124
<i>TABLE 46 U.S. TRAYS MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	125
PLASTIC STENTS	125
CHAPTER 12 RESINS USED IN MEDICAL DEVICES	128
BACKGROUND	128
MATERIAL SELECTION	128
TARGETED AREAS FOR MEDICAL PLASTICS	128
EXAMPLE OF POTENTIAL PROBLEMS ENCOUNTERED IN USING SPECIFIC POLYMERS FOR MEDICAL APPLICATIONS IN HOSPITAL ENVIRONMENTS	129
RESINS	129
BACKGROUND	129
COMMODITY THERMOPLASTICS	130
STYRENICS	130
ENGINEERING RESINS	130
THERMOSET RESINS	130
ELASTOMERS	131
MISCELLANEOUS RESINS	131
CHANGING REQUIREMENTS	131
PROPERTY REQUIREMENTS	131
OTHER DEVELOPMENTS	132
FAILURE OF PLASTIC MEDICAL DEVICES	133
PHYSICAL PROPERTY EFFECTS ON RESIN MATERIALS	133
OVERVIEW	133
IMPACT STRENGTH	133
STRESS-STRAIN BEHAVIOR	134
HEAT RESISTANCE	134
CHEMICAL RESISTANCE	134
CLARITY OR TRANSPARENCY	135
BONDABILITY	135
SUMMARY OF PHYSICAL PROPERTY CHARACTERISTICS OF MEDICAL PLASTICS	135

TOPIC	PAGE NO.
<i>TABLE 47 PHYSICAL PROPERTY, ADVANTAGES AND DISADVANTAGES OF MEDICAL PLASTIC</i>	136
USE OF PLASTICS IN MEDICAL DEVICES	137
OVERVIEW	137
OVERALL RESIN USAGE	137
<i>TABLE 48 SELECTED RESIN USAGE BY TYPE OF MEDICAL DEVICE</i>	137
SEVERAL REASONS WHY MEDICAL PLASTICS WILL CHANGE IN THE NEXT FIVE YEARS	138
MEDICAL PLASTICS MARKET ESTIMATES AND FORECASTS	138
<i>TABLE 49 U.S. MEDICAL PLASTICS MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	138
<i>TABLE 50 U.S. DISPOSABLE MEDICAL MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	139
<i>TABLE 51 U.S. NONDISPOSABLE MEDICAL MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	140
CHAPTER 13 COMMODITY THERMOPLASTICS	142
POLYVINYL CHLORIDE	142
OVERVIEW	142
FORMS OF PVC	142
A VERSATILE RESIN	142
PROCESSING	143
Background	143
Extrusion	143
Calendering	143
CONSUMPTION PATTERNS	143
ENVIRONMENTAL ISSUES	143
Positive	143
Negative	144
PRODUCERS AND CAPACITIES	144
<i>TABLE 52 LEADING GLOBAL PVC PRODUCERS</i>	144
PVC MEDICAL DEVICE HISTORY	145
MEDICAL APPLICATIONS	145
STERILIZATION OF PVC	145
PVC STILL A FAVORITE FOR MEDICAL DISPOSABLE DEVICES	146
THE PVC REPLACEMENT ISSUE	146
Background	146
PVC Replacement Candidates	147
Overview	147
TPEs	147
Polyolefins	148
Ethylene Vinyl Acetate (EVA)	148
COPEs	148
Laminated Polyolefins	148
Polyolefin Blends	148
Functionalized Polyolefins	148
Polyurethanes	149
WOULD PHTHALATE-FREE PVC SLOW/STOP MARKET EROSION	149

TOPIC	PAGE NO.
POLYPROPYLENE	149
BACKGROUND	149
OVERVIEW	149
PROPERTIES	150
Background	150
Polypropylene Property Advances	150
ADVANCES IN POLYPROPYLENE TECHNOLOGIES	150
HIGHLY CRYSTALLINE GRADES	151
RANDOM COPOLYMER POLYPROPYLENES	151
TECHNIQUES USED TO IMPART CLARITY	151
POLYPROPYLENE FILMS	152
APPLICATIONS	152
STERILIZATION OF POLYPROPYLENE	152
ADVANTAGEOUS MEDICAL PROPERTIES	153
PRODUCERS AND CAPACITIES	153
<i>TABLE 53 LEADING GLOBAL POLYPROPYLENE PRODUCERS</i>	153
EXAMPLES OF POLYPROPYLENE MEDICAL DEVICES	153
POLYETHYLENES	154
BACKGROUND	154
HIGH DENSITY POLYETHYLENE (HDPE)	154
Overview	154
Background	154
Processing of HDPE	155
Producers	155
<i>TABLE 54 LEADING GLOBAL HDPE PRODUCERS (BILLION POUNDS/YEAR)</i>	155
Recycling Aspects	156
LOW DENSITY POLYETHYLENE (LDPE)	156
Overview	156
Properties	156
Markets and Applications	157
Producers	157
<i>TABLE 55 GLOBAL LDPE PRODUCERS AND LOCATIONS</i>	157
Properties Useful for Medical Devices	157
Specific Examples of Medical Devices	158
Sterilization of Polyethylenes	158
Joint Replacements Depend on Polyethylene Resins	158
MARKET ESTIMATES AND FORECASTS	159
<i>TABLE 56 U.S. COMMODITY THERMOPLASTIC MEDICAL MARKET BY TYPE, THROUGH 2020 (MILLION POUNDS)</i>	159
<i>TABLE 57 U.S. COMMODITY THERMOPLASTICS BY DISPOSABLE MEDICAL APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	160
<i>TABLE 58 U.S. DISPOSABLE COMMODITY THERMOPLASTIC MEDICAL MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	160
<i>TABLE 59 U.S. DISPOSABLE PVC MEDICAL MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	161
<i>TABLE 60 U.S. DISPOSABLE POLYPROPYLENE MEDICAL MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	161
<i>TABLE 61 U.S. DISPOSABLE HDPE MEDICAL MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	162

TOPIC	PAGE NO.
<i>TABLE 62 U.S. DISPOSABLE LDPE/LLDPE MEDICAL MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	162
<i>TABLE 63 U.S. COMMODITY THERMOPLASTICS BY NONDISPOSABLE MEDICAL APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	162
<i>TABLE 64 U.S. NONDISPOSABLE COMMODITY THERMOPLASTIC MEDICAL MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	163
<i>TABLE 65 U.S. NONDISPOSABLE PVC MEDICAL MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	164
<i>TABLE 66 U.S. NONDISPOSABLE POLYPROPYLENE MEDICAL MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	164
<i>TABLE 67 U.S. NONDISPOSABLE HDPE MEDICAL MARKET BY APPLICATION, THROUGH 2015 (MILLION POUNDS)</i>	165
CHAPTER 14 STYRENIC RESINS	167
OVERVIEW	167
POLYSTYRENE	167
OVERVIEW	167
GENERAL PURPOSE POLYSTYRENE (GPPS)	167
Background	167
Characteristics of General Purpose Polystyrene	168
Specialty Grades	168
HIGH IMPACT POLYSTYRENE (HIPS)	168
Background	168
Properties	168
Applications	168
Several Specific Examples of Polystyrene Applications	169
RECENT STYRENIC POLYMER PRODUCER CHANGES	169
MARKET PLAYERS AND INDUSTRY LEADERS	169
PROCESSING	170
Overview	170
<i>TABLE 68 FABRICATION METHODS AND USES FOR POLYSTYRENE</i>	170
Injection Molding	170
MEDICAL APPLICATIONS OF POLYSTYRENE AND HIPS	170
STYRENE COPOLYMERS	171
OVERVIEW	171
STYRENE BLOCK COPOLYMERS	171
Overview	171
Processing	172
<i>TABLE 69 SBC MAJOR PRODUCTS SEGMENTED BY POLYMER PROCESS</i>	172
Properties	173
Producers	173
Styrolux SBC/GPPS Blends	173
Chevron-Phillips K-Resin	174
Medical Applications	174
Styrolux Details	174
ACRYLONITRILE-BUTADIENE-STYRENE (ABS)	175
Overview	175
Background	175
Properties	175

TOPIC	PAGE NO.
Processing	176
Key Global ABS Producers and Trade Named Products	176
General Grades	176
Applications	177
Medically Related Properties	177
Medical Product Applications	178
STYRENE-ACRYLIC COPOLYMERS	178
Overview	178
Properties and Blending	178
Applications	179
STYRENE-ACRYLONITRILE COPOLYMERS (SAN)	179
Overview	179
Properties	180
Producers	180
Medical Applications	180
Market Estimates and Forecasts	181
<i>TABLE 70 STYRENIC RESIN MEDICAL MARKET BY TYPE OF RESIN, THROUGH 2020 (MILLION POUNDS)</i>	181
<i>TABLE 71 U.S. DISPOSABLE STYRENIC RESIN MEDICAL MARKET BY TYPE OF RESIN, THROUGH 2020 (MILLION POUNDS)</i>	181
<i>TABLE 72 U.S. STYRENIC RESINS MARKET BY DISPOSABLE MEDICAL APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	182
<i>TABLE 73 U.S. DISPOSABLE POLYSTYRENE/HIPS MEDICAL MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	182
<i>TABLE 74 U.S. NONDISPOSABLE STYRENIC RESIN MEDICAL MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	183
<i>TABLE 75 U.S. STYRENIC RESINS MARKET BY NONDISPOSABLE MEDICAL APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	183
<i>TABLE 76 U.S. NONDISPOSABLE POLYSTYRENE/HIPS MEDICAL MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	184
<i>TABLE 77 U.S. NONDISPOSABLE ABS MEDICAL MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	184
CHAPTER 15 ENGINEERING RESINS	186
OVERVIEW	186
POLYCARBONATES	186
OVERVIEW	186
IMPACT OF BISPHENOL A ON POLYCARBONATE USAGE	186
PROCESSING	186
PROPERTY ADVANTAGES AND DISADVANTAGES	187
GENERAL GRADES	187
ALLOYS/BLENDS	187
PRODUCERS	187
<i>TABLE 78 KEY GLOBAL POLYCARBONATE TRADE NAMED PRODUCTS AND PRODUCERS</i>	188
CAPACITIES AND DEMAND	188
MEDICAL PROPERTIES AND APPLICATIONS	189
Overview	189
Specific Examples	190

TOPIC	PAGE NO.
Renal Dialysis	190
Surgical Instruments	190
Cardiac Surgery Products	190
Polycarbonate Sterilization	190
NYLON	191
BACKGROUND	191
PROPERTIES	191
MAJOR TYPES OF NYLONS	191
Nylon 66	191
Nylon 6	192
Other Nylons	192
Overview	192
Nylon 46	192
Nylon 6/9	192
Nylon 6/10 and 6/12	192
Nylon 11	193
Nylon 12	193
PROCESSING	193
OVERALL APPLICATIONS OF NYLONS	193
PRODUCERS AND CAPACITIES	193
<i>TABLE 79 KEY GLOBAL NYLON RESIN PRODUCERS</i>	194
NYLON STERILIZATION	194
MEDICAL APPLICATIONS	194
THERMOPLASTIC POLYESTERS (POLYETHYLENE TEREPHTHALATE - PET)	195
OVERVIEW	195
MAJOR APPLICATIONS	195
MODIFIED PET RESINS	195
Background	195
APET	195
CPET	196
PETG	196
PRODUCERS AND CAPACITIES	196
<i>TABLE 80 THE TEN LARGEST GLOBAL PET PRODUCERS</i>	196
MEDICAL APPLICATIONS	197
STERILIZATION AND DISPOSAL	197
POLYBUTYLENE TEREPHTHALATE (PBT)	198
Background	198
Properties	198
PBT Trade-Named Products	198
Polyester Properties and Medical Applications	198
POLYACETALS	199
BACKGROUND	199
GRADES	199
PROPERTIES	200
PROCESSING	200
<i>TABLE 81 KEY GLOBAL POLYACETAL PRODUCERS AND TRADE NAMED PRODUCTS</i>	201
TYPICAL APPLICATIONS	201

TOPIC	PAGE NO.
<i>TABLE 82 TYPICAL APPLICATIONS OF POLYACETALS</i>	201
MEDICAL PRODUCTS	202
SPECIFIC POLYACETALS AIMED AT MEDICAL PRODUCTS	202
RECENT POLYACETAL MEDICAL PRODUCTS	202
POLYSULFONES	202
BACKGROUND AND PROPERTIES	202
TYPES OF POLYSULFONES	203
APPLICATIONS	203
ELECTRICAL/ELECTRONIC APPLICATIONS	203
MEDICAL PROPERTIES AND APPLICATIONS	204
SPECIFIC POLYSULFONE MEDICAL PRODUCTS	205
PRODUCER SCENARIO	205
<i>TABLE 83 GLOBAL CAPACITY OF POLYSULFONE POLYMERS</i>	205
RECENT DEVELOPMENTS	206
BASF Opens Polysulfone Plant in South Korea	206
Polysulfones Used for Stethoscope in Noisy Areas	206
POLYIMIDES	206
BACKGROUND	206
POLYETHERIMIDES (PEI)	207
Overview	207
Producers	207
Applications	207
KEY POLYAMIDE PRODUCTS AND PRODUCERS	208
RECENT DEVELOPMENTS	208
POLYKETONES	208
BACKGROUND	208
PROPERTIES	208
MEDICAL APPLICATIONS	209
Overview	209
PEEK Implants	209
PRODUCERS	209
CAPACITIES	209
<i>TABLE 84 GLOBAL PRODUCERS AND CAPACITIES OF POLYKETONES (MILLION LBS/YEAR)</i>	210
NEW DEVELOPMENTS	210
PEEK Resins for Small Pipette Tips	210
PEEK Rods Chosen for Spinal Implant	210
FDA Approves First Porous PEEK-Based Medical Device.	210
PEKK MAY BE ABLE TO ELIMINATE IMPLANT INFECTIONS	211
LIQUID CRYSTAL POLYMERS	211
BACKGROUND	211
PROPERTIES	211
APPLICATIONS	212
MEDICAL PROPERTIES, PRODUCTS AND STERILIZATION	212
PRODUCERS	213
<i>TABLE 85 GLOBAL LIQUID CRYSTAL POLYMER PRODUCERS AND ESTIMATED CAPACITIES (MILLION LBS/YEAR)</i>	213
ENGINEERING RESIN MARKET ESTIMATES AND FORECASTS	213

TOPIC	PAGE NO.
<i>TABLE 86 U.S. ENGINEERING RESIN MEDICAL MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	213
<i>TABLE 87 U.S. DISPOSABLE ENGINEERING RESIN MEDICAL MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	214
<i>TABLE 88 U.S. ENGINEERING RESINS BY DISPOSABLE MEDICAL APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	215
<i>TABLE 89 U.S. DISPOSABLE POLYCARBONATE MEDICAL MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	215
<i>TABLE 90 U.S. DISPOSABLE POLYESTER MEDICAL MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	215
<i>TABLE 91 U.S. NONDISPOSABLE POLYCARBONATE MEDICAL MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	216
CHAPTER 16 THERMOSET RESINS	218
ACRYLICS	218
BACKGROUND	218
PROPERTIES	218
MANUFACTURE OF ACRYLIC POLYMERS	218
ACRYLIC SHEET	219
APPLICATIONS	219
IMPORTANT ACRYLIC PRODUCING COMPANIES	220
Altuglas	220
Cyro Industries	220
Lucite International	220
Aristech Acrylic LLC	220
Plaskolite	221
Sabic IP and Mitsubishi Form Acrylic Joint Venture	221
KEY TRADE NAMED POLYACRYLATES	221
MEDICAL PRODUCTS AND STERILIZATION	221
USE IN MEDICAL DEVICES	221
Recent Development	222
Altuglas Develops New PMMA Alloy for Medical Devices	222
SILICONES	222
BACKGROUND	222
TECHNOLOGY	222
MEDICAL APPLICATIONS	223
SILICONE MEDICAL DEVICE PRODUCERS	223
<i>TABLE 92 SELECTED KEY SILICONE MEDICAL DEVICE PRODUCERS</i>	223
RECENT DEVELOPMENT	224
Dow Corning Introduces New Group of Products	224
POLYURETHANES	224
OVERVIEW	224
GENERAL MEDICAL APPLICATIONS	224
RECENT DEVELOPMENT	225
Parker Hannifin Increases Role in Medical Polyurethanes	225
MARKET ESTIMATES	225
<i>TABLE 93 U.S. THERMOSET MEDICAL MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	226

TOPIC	PAGE NO.
<i>TABLE 94 U.S. DISPOSABLE THERMOSET RESIN MEDICAL MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)</i>	226
<i>TABLE 95 U.S. THERMOSET RESINS BY DISPOSABLE MEDICAL APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	226
<i>TABLE 96 U.S. DISPOSABLE ACRYLIC MEDICAL MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	227
<i>TABLE 97 U.S. DISPOSABLE SILICONE MEDICAL MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	227
<i>TABLE 98 U.S. THERMOSET RESINS BY NONDISPOSABLE MEDICAL APPLICATIONS, THROUGH 2020 (MILLION POUNDS)</i>	228
<i>TABLE 99 U.S. NONDISPOSABLE ACRYLIC MEDICAL MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	228
CHAPTER 17 THERMOPLASTIC ELASTOMERS (TPES)	230
OVERVIEW	230
ADVANTAGES	230
DISADVANTAGES	230
PROCESSING	231
APPLICATIONS	231
THERMOPLASTIC OLEFINS (TPOS)	231
BACKGROUND AND PROPERTIES	231
OVERVIEW	231
GENERAL APPLICATIONS	232
MEDICAL APPLICATIONS	232
COMPETITIVE SCENARIO	233
COPEs (COPOLYESTERS)	233
Background	233
Properties and Medical Applications	233
DISADVANTAGES OF TPES	234
PROCESSING	234
APPLICATIONS	234
THERMOPLASTIC POLYURETHANES (TPUS)	234
Background	234
Medical Properties and Sterilization	235
Medical Products	235
TPU-SILICONE COPOLYMERS	235
<i>TABLE 100 SELECTED MEDICAL SILICONE-POLYURETHANE COPOLYMER PRODUCTS</i>	236
RECENT DEVELOPMENTS	236
Compounders Increase Development of Medical Elastomers	236
High-Purity Medical TPVs for Syringes Stoppers	236
Transparent Medical TPEs	237
Rigid TPVs for Medical Applications	237
Aromatic TPUs for Long-Term Implants	237
MARKET ESTIMATES AND FORECASTS	237
<i>TABLE 101 U.S. TPE MEDICAL MARKET BY TYPE, THROUGH 2020 (MILLION POUNDS)</i>	237
<i>TABLE 102 U.S. TPE MARKET BY DISPOSABLE MEDICAL APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	238
CHAPTER 18 POLYMER ALLOYS/BLENDS	240

TOPIC	PAGE NO.
BACKGROUND	240
PPO/HIPS	240
OVERVIEW	240
GRADES	241
PROCESSING	241
APPLICATIONS	241
PROPERTIES AND ADVANTAGES	241
MEDICAL PRODUCTS	241
PC/ABS	242
BACKGROUND	242
TRADE NAMED PRODUCTS	242
USE IN MEDICAL DEVICES	242
NEW DEVELOPMENT	243
Bayer Material Science Introduces New PC/ABS Grades for Medical Equipment	243
CHAPTER 19 BIOPOLYMERS/BIODEGRADABLE POLYMERS	245
OVERVIEW	245
EXPECTED GROWTH OF BIODEGRADABLE POLYMER SUTURES	245
TYPES OF BIODEGRADABLE POLYMERS USED IN MEDICAL APPLICATIONS	245
<i>EXAMPLE OF A BIODEGRADABLE POLYMER COMMERCIAL IMPLANTABLE DEVICE</i>	246
POLYMERS FOR CONTROLLED DELIVERY	246
BACKGROUND	246
MARKET ESTIMATES AND FORECASTS	247
RECENT DEVELOPMENTS	247
RESEARCH CONTINUES ON PLA-BASED STENTS	247
PLLA-BASED WOUND DRESSINGS ADHERE TO IRREGULAR BODY SURFACES	247
CHAPTER 20 MISCELLANEOUS RESINS	249
OVERVIEW	249
FLUOROPOLYMERS	249
BACKGROUND	249
MEDICAL PRODUCTS	249
FLUOROPOLYMER MEDICAL DEVICE SUPPLIERS	250
<i>TABLE 103 SELECTED FLUOROPOLYMER MEDICAL DEVICE SUPPLIERS</i>	250
<i>TABLE 104 MISCELLANEOUS RESINS MARKET BY MEDICAL APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	250
<i>TABLE 105 U.S. MISCELLANEOUS RESINS MARKET BY NONDISPOSABLE MEDICAL APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	251
<i>TABLE 106 U.S. MISCELLANEOUS RESINS MARKET BY DISPOSABLE MEDICAL APPLICATION, THROUGH 2020 (MILLION POUNDS)</i>	251
CHAPTER 21 PLASTIC MEDICAL DEVICE MOLDERS	253
BACKGROUND	253
OUTLOOK FOR INJECTION MOLDING OF MEDICAL DEVICES	253
RECENT MEDICAL MOLDER DEVELOPMENTS	254
MACK MOLDING	254

TOPIC	PAGE NO.
MOLL INDUSTRIES	254
TESSY PLASTICS	254
APEC INDUSTRIES	254
LEADING U.S. MEDICAL INJECTION MOLDERS	254
<i>TABLE 107 LEADING U.S. MEDICAL INJECTION MOLDERS (\$ MILLIONS)</i>	255
LEADING MEDICAL FILM AND SHEET MANUFACTURERS	255
<i>TABLE 108 LEADING U.S. MEDICAL FILM AND SHEET MANUFACTURERS (\$ MILLIONS)</i>	255
LEADING MEDICAL BLOW MOLDERS	256
<i>TABLE 109 LEADING U.S. MEDICAL BLOW MOLDERS (\$ MILLIONS)</i>	256
LEADING U.S. MEDICAL THERMOFORMERS	256
<i>TABLE 110 LEADING U.S. MEDICAL THERMOFORMERS (\$ MILLIONS)</i>	257
CHAPTER 22 MEDICAL RESIN PRODUCERS	259
<i>TABLE 111 SELECTED TRADE NAMED PRODUCTS, TYPES OF RESINS, AND PRODUCERS USED IN MEDICAL DEVICES</i>	259
CHAPTER 23 CONFERENCES/MEETINGS INVOLVING THE MEDICAL DEVICE INDUSTRY	262
PLASTICS IN MEDICAL DEVICES: 2013	262
PLASTICS IN MEDICAL DEVICES: 2014	262
MEDTECHWORLD, MDM: OCTOBER, 2014	262
MEDICAL PLASTIC'S APRIL, 2015 CONFERENCE ON POLYMERS AND PLASTICS IN MEDICAL DEVICES	263
CHAPTER 24 NEW COMPANY DEVELOPMENTS	265
POLYONE INTRODUCES NEW PVC AND TPV MEDICAL COMPOUND	265
EVONIK CYRO LAUNCHES ALLOYS FOR MEDICAL USAGE	265
NEW LUBRIZOL MEDICAL PRODUCTS	265
ARKEMA PLANNING TO RESTRICT RESIN USAGE IN MEDICAL APPLICATIONS	265
CORNING BUYS BECTON-DICKINSON LABWARE UNIT	265
MEDTRONIC BUYS CHINESE MEDICAL DEVICE COMPANY	266
SAINT-GOBAIN PURCHASES U.S. MEDICAL BAG PRODUCER	266
BOREALIS MEDICAL RESINS EXPANDS IN THE U.S.	266
BAYER MATERIAL SCIENCE INCREASING ITS MEDICAL RESINS	266
TRITAN POLYESTERS FIND NEW MEDICAL USES	266
PARKER HANNIFIN INCREASES ITS ROLE IN MEDICAL POLYURETHANES	267
DSM INTRODUCES UHMWPE FIBER FOR MINIMALLY EVASIVE SURGERIES	267
POLYONE INTRODUCES NEW CATHETER	267
EVONIK EXPANDS MEDICAL PRODUCT LINE	267
LUBRIZOL BUYS MEDICAL EXTRUDER	268
NYPRO INCREASES ITS PRESENCE IN THE MEDICAL MARKET	268
DUPONT INTRODUCES FIRST MEDICAL DEVICE WITH SORONA POLYMER	268
BECTON DICKINSON BUYS CAREFUSION	268
CHAPTER 25 NEW TECHNOLOGIES	270
MEDICAL IMPLANT POLYMERS HAVE UNIQUE CHALLENGES	270
ELECTRICALLY STIMULATED POLYMERS FOR MEDICAL DEVICES	270
OTHER ADVANCES IN MEDICAL DEVICE TECHNOLOGY	270
LARGER ROLE EXPECTED FOR POLYCARBONATE BODY EXOSKELETONS	271

TOPIC	PAGE NO.
WEARABLE LUNG	271
WILL GENERICS BE A FACTOR IN THE MEDICAL DEVICE MARKET?	271
NEW COMBINATION MEDICAL DEVICES	272
SYNTHETIC BIOABSORBABLES AIMED AT NEW MEDICAL APPLICATIONS	272
SPINAL SURGERY DRIVES NEW APPROACHES	272
EASTMAN CHEMICAL INTRODUCES A HIGH PURITY NON-PHTHALATE PLASTICIZER	272
PLASTIC-COATED PLATELETS COULD REDUCE INTERNAL BLEEDING	273
USING MORE PLASTICS IN ACUPUNCTURE	273
<i>USE OF POLYSULFONES IN IMPLANTABLE BRAIN SURGERY</i>	273
3D-PRINTED CARDIO MODEL ARE NOW CLASS I MEDICAL DEVICES	273
STRETCHABLE HYDROGELS FOR ARTIFICIAL MUSCLES	273
CHAPTER 26 COMPANY PROFILES OF KEY SUPPLIERS, PROCESSORS AND COMPOUNDERS OF PLASTICS FOR MEDICAL DEVICES	275
ADVANCED POLYMERS	275
ALLERGAN	275
ALPHAGARY CORP.	275
APEX MEDICAL TECHNOLOGIES	276
BARD MEDICAL DIVISION (C.R. BARD INC.)	276
BAXTER INC.	277
BECTON DICKINSON AND COMPANY	277
B. BRAUN MEDICAL, INC.	278
CATALENT PHARMA SOLUTIONS	278
COVIDIEN	279
DA/PRO RUBBER	279
DUNN INDUSTRIES INC.	280
ETHOX INTERNATIONAL INC.	280
FILTERTEK INC.	280
FLEXTRONICS MEDICAL COMPANY	281
FLUORTEK INC.	281
GW PLASTICS	282
GLS THERMOPLASTIC ELASTOMERS	282
HARMAC MEDICAL PRODUCTS	282
HELIX MEDICAL INC.	283
HOSPIRA, INCORPORATED	283
INTERNATIONAL POLYMER ENGINEERING	284
MANAN MEDICAL PRODUCTS	284
MEDEGEN LLC.	284
MEDICAL PLASTIC DEVICES INC.	285
MEDICAL POLYMERS INC.	285
MEDPLAST INC.	286
MICROLUMEN INC.	286
NDH MEDICAL INC.	287
NEW ENGLAND URETHANE INC.	287
PRECISION EXTRUSION INC.	288
PROFESSIONAL PLASTICS	288
PUTNAM PLASTICS COMPANY LLC	289

TOPIC	PAGE NO.
SAINT GOBAIN PERFORMANCE PLASTICS	289
SPIRE BIOMEDICAL INC.	290
TELEFLEX MEDICAL	290
THERMO FISCHER SCIENTIFIC, INC.	291
VANCIVE MEDICAL TECHNOLOGIES	291
W.L. GORE AND ASSOCIATES	291
CHAPTER 27 SELECTED KEY ACRONYMS	294

LIST OF TABLES

TABLE HEADING	PAGE NO.
SUMMARY TABLE U.S. MEDICAL PLASTICS MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)	6
TABLE 1 U.S. MEDICAL INDUSTRY: PRINCIPAL MATERIALS, PRODUCER TYPES, MAJOR PRODUCTS AND PRINCIPAL CONSUMERS	21
TABLE 2 CURRENT LEADING U.S. MEDICAL DEVICES COMPANIES, 2013 (\$ MILLIONS)	21
TABLE 3 SELECTED RESIN USAGE BY TYPE OF MEDICAL DEVICE	24
TABLE 4 RADIATION RESISTANCE OF KEY MEDICAL PLASTICS	53
TABLE 5 SELECTED TESTS FOR PLASTICS USED IN MEDICAL APPLICATIONS	56
TABLE 6 SELECTED/RANDOM EXAMPLES OF STERILIZATION STANDARDS FOR MEDICAL DEVICES	56
TABLE 7 U.S. MEDICAL PLASTICS MARKET BY OVERALL APPLICATION, THROUGH 2020 (MILLION POUNDS)	62
TABLE 8 U.S. NONDISPOSABLE MEDICAL PLASTIC MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	63
TABLE 9 SELECTED KEY MANUFACTURERS OF SURGICAL INSTRUMENTS	68
TABLE 10 U.S. SURGICAL INSTRUMENT/RELATED EQUIPMENT MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)	69
TABLE 11 U.S. COMMODITY THERMOPLASTIC SURGICAL INSTRUMENTS/RELATED EQUIPMENT MARKET, THROUGH 2020 (MILLION POUNDS)	69
TABLE 12 U.S. STYRENIC RESIN SURGICAL INSTRUMENTS/RELATED EQUIPMENT MARKET, THROUGH 2020 (MILLION POUNDS)	69
TABLE 13 U.S. MARKET IN OTHER RESINS IN SURGICAL INSTRUMENTS/RELATED EQUIPMENT, THROUGH 2020 (MILLION POUNDS)	70
TABLE 14 KEY SELECTED MEDICAL TESTING AND DIAGNOSTIC COMPANIES	71
TABLE 15 U.S. TESTING/DIAGNOSTIC EQUIPMENT MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)	73
TABLE 16 U.S. COMMODITY THERMOPLASTIC TESTING/DIAGNOSTIC EQUIPMENT MARKET, THROUGH 2020 (MILLION POUNDS)	74
TABLE 17 U.S. STYRENIC RESIN TESTING/DIAGNOSTIC EQUIPMENT MARKET, THROUGH 2020 (MILLION POUNDS)	74
TABLE 18 U.S. MARKET IN OTHER RESINS IN TESTING/DIAGNOSTIC EQUIPMENT, THROUGH 2020 (MILLION POUNDS)	75
TABLE 19 U.S. PROSTHESES/IMPLANTS MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)	80
TABLE 20 U.S. COMMODITY THERMOPLASTIC PROSTHESES/IMPLANTS MARKET, THROUGH 2020 (MILLION POUNDS)	80
TABLE 21 U.S. MARKET IN OTHER RESINS USED IN PROSTHESES/IMPLANTS, THROUGH 2020 (MILLION POUNDS)	80
TABLE 22 U.S. DENTAL/OPHTHALMIC MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)	84
TABLE 23 SPECIFIC RESIN USAGE IN U.S. DENTAL/OPHTHALMIC MARKET, THROUGH 2020 (MILLION POUNDS)	84
TABLE 24 U.S. DISPOSABLE MEDICAL PLASTIC MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	86
TABLE 25 SELECTED KEY MEDICAL BAG MANUFACTURERS	90
TABLE 25 SELECTED KEY MEDICAL BAG MANUFACTURERS	90
TABLE 26 U.S. MEDICAL BAG MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)	91
TABLE 27 OTHER SELECTED SYRINGE MANUFACTURERS	97
TABLE 28 U.S. SYRINGES MARKET BY RESIN THROUGH 2020 (MILLION POUNDS)	97
TABLE 29 EXAMPLES OF DISPOSABLE MEDICAL PLASTIC LABWARE	98

TABLE HEADING	PAGE NO.
TABLE 30 SELECTED PLASTIC MEDICAL LABWARE SUPPLIERS	99
TABLE 31 U.S. MEDICAL LABWARE MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)	100
TABLE 32 RESIN PROPERTY CRITERIA-CATHETERS	102
TABLE 33 SELECTED KEY CATHETER MANUFACTURERS	105
TABLE 34 U.S. CATHETER/IV UNIT MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)	105
TABLE 35 MATERIAL PROPERTY CRITERIA- KITS	108
TABLE 36 U.S. KITS MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)	109
TABLE 37 COMMON FEATURES OF SELECTED APPLICATIONS FOR PRIMARY RESINS USED IN MEDICAL TUBING	111
TABLE 38 SAMPLE APPLICATIONS FOR FLEXIBLE MEDICAL TUBING BY MAJOR CATEGORY	112
TABLE 39 SELECTED PLASTIC MEDICAL TUBING EXTRUDERS	115
TABLE 40 U.S. TUBING MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)	115
TABLE 41 SELECTED KEY MEDICAL GLOVE MANUFACTURERS AND MAJOR PRODUCTS	118
TABLE 42 U.S. MEDICAL GLOVE MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)	119
TABLE 43 U.S. MEDICAL UTENSIL MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)	120
TABLE 44 RESIN PROPERTY CRITERIA-TRAYS	122
TABLE 45 SELECTED PLASTIC MEDICAL TRAY MANUFACTURERS	124
TABLE 46 U.S. TRAYS MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)	125
TABLE 47 PHYSICAL PROPERTY, ADVANTAGES AND DISADVANTAGES OF MEDICAL PLASTIC	136
TABLE 48 SELECTED RESIN USAGE BY TYPE OF MEDICAL DEVICE	137
TABLE 49 U.S. MEDICAL PLASTICS MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)	138
TABLE 50 U.S. DISPOSABLE MEDICAL MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)	139
TABLE 51 U.S. NONDISPOSABLE MEDICAL MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)	140
TABLE 52 LEADING GLOBAL PVC PRODUCERS	144
TABLE 53 LEADING GLOBAL POLYPROPYLENE PRODUCERS	153
TABLE 54 LEADING GLOBAL HDPE PRODUCERS (BILLION POUNDS/YEAR)	155
TABLE 55 GLOBAL LDPE PRODUCERS AND LOCATIONS	157
TABLE 56 U.S. COMMODITY THERMOPLASTIC MEDICAL MARKET BY TYPE, THROUGH 2020 (MILLION POUNDS)	159
TABLE 57 U.S. COMMODITY THERMOPLASTICS BY DISPOSABLE MEDICAL APPLICATION, THROUGH 2020 (MILLION POUNDS)	160
TABLE 58 U.S. DISPOSABLE COMMODITY THERMOPLASTIC MEDICAL MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)	160
TABLE 59 U.S. DISPOSABLE PVC MEDICAL MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	161
TABLE 60 U.S. DISPOSABLE POLYPROPYLENE MEDICAL MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	161
TABLE 61 U.S. DISPOSABLE HDPE MEDICAL MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	162
TABLE 62 U.S. DISPOSABLE LDPE/LLDPE MEDICAL MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	162

TABLE HEADING	PAGE NO.
TABLE 63 U.S. COMMODITY THERMOPLASTICS BY NONDISPOSABLE MEDICAL APPLICATION, THROUGH 2020 (MILLION POUNDS)	162
TABLE 64 U.S. NONDISPOSABLE COMMODITY THERMOPLASTIC MEDICAL MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)	163
TABLE 65 U.S. NONDISPOSABLE PVC MEDICAL MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	164
TABLE 66 U.S. NONDISPOSABLE POLYPROPYLENE MEDICAL MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	164
TABLE 67 U.S. NONDISPOSABLE HDPE MEDICAL MARKET BY APPLICATION, THROUGH 2015 (MILLION POUNDS)	165
TABLE 68 FABRICATION METHODS AND USES FOR POLYSTYRENE	170
TABLE 69 SBC MAJOR PRODUCTS SEGMENTED BY POLYMER PROCESS	172
TABLE 70 STYRENIC RESIN MEDICAL MARKET BY TYPE OF RESIN, THROUGH 2020 (MILLION POUNDS)	181
TABLE 71 U.S. DISPOSABLE STYRENIC RESIN MEDICAL MARKET BY TYPE OF RESIN, THROUGH 2020 (MILLION POUNDS)	181
TABLE 72 U.S. STYRENIC RESINS MARKET BY DISPOSABLE MEDICAL APPLICATION, THROUGH 2020 (MILLION POUNDS)	182
TABLE 73 U.S. DISPOSABLE POLYSTYRENE/HIPS MEDICAL MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	182
TABLE 74 U.S. NONDISPOSABLE STYRENIC RESIN MEDICAL MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)	183
TABLE 75 U.S. STYRENIC RESINS MARKET BY NONDISPOSABLE MEDICAL APPLICATION, THROUGH 2020 (MILLION POUNDS)	183
TABLE 76 U.S. NONDISPOSABLE POLYSTYRENE/HIPS MEDICAL MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	184
TABLE 77 U.S. NONDISPOSABLE ABS MEDICAL MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	184
TABLE 78 KEY GLOBAL POLYCARBONATE TRADE NAMED PRODUCTS AND PRODUCERS	188
TABLE 79 KEY GLOBAL NYLON RESIN PRODUCERS	194
TABLE 80 THE TEN LARGEST GLOBAL PET PRODUCERS	196
TABLE 81 KEY GLOBAL POLYACETAL PRODUCERS AND TRADE NAMED PRODUCTS	201
TABLE 82 TYPICAL APPLICATIONS OF POLYACETALS	201
TABLE 83 GLOBAL CAPACITY OF POLYSULFONE POLYMERS	205
TABLE 84 GLOBAL PRODUCERS AND CAPACITIES OF POLYKETONES (MILLION LBS/YEAR)	210
TABLE 85 GLOBAL LIQUID CRYSTAL POLYMER PRODUCERS AND ESTIMATED CAPACITIES (MILLION LBS/YEAR)	213
TABLE 86 U.S. ENGINEERING RESIN MEDICAL MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)	213
TABLE 87 U.S. DISPOSABLE ENGINEERING RESIN MEDICAL MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)	214
TABLE 88 U.S. ENGINEERING RESINS BY DISPOSABLE MEDICAL APPLICATION, THROUGH 2020 (MILLION POUNDS)	215
TABLE 89 U.S. DISPOSABLE POLYCARBONATE MEDICAL MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	215
TABLE 90 U.S. DISPOSABLE POLYESTER MEDICAL MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	215
TABLE 91 U.S. NONDISPOSABLE POLYCARBONATE MEDICAL MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	216
TABLE 92 SELECTED KEY SILICONE MEDICAL DEVICE PRODUCERS	223

TABLE HEADING	PAGE NO.
TABLE 93 U.S. THERMOSET MEDICAL MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)	226
TABLE 94 U.S. DISPOSABLE THERMOSET RESIN MEDICAL MARKET BY RESIN, THROUGH 2020 (MILLION POUNDS)	226
TABLE 95 U.S. THERMOSET RESINS BY DISPOSABLE MEDICAL APPLICATION, THROUGH 2020 (MILLION POUNDS)	226
TABLE 96 U.S. DISPOSABLE ACRYLIC MEDICAL MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	227
TABLE 97 U.S. DISPOSABLE SILICONE MEDICAL MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	227
TABLE 98 U.S. THERMOSET RESINS BY NONDISPOSABLE MEDICAL APPLICATIONS, THROUGH 2020 (MILLION POUNDS)	228
TABLE 99 U.S. NONDISPOSABLE ACRYLIC MEDICAL MARKET BY APPLICATION, THROUGH 2020 (MILLION POUNDS)	228
TABLE 100 SELECTED MEDICAL SILICONE-POLYURETHANE COPOLYMER PRODUCTS	236
TABLE 101 U.S. TPE MEDICAL MARKET BY TYPE, THROUGH 2020 (MILLION POUNDS)	237
TABLE 102 U.S. TPE MARKET BY DISPOSABLE MEDICAL APPLICATION, THROUGH 2020 (MILLION POUNDS)	238
TABLE 103 SELECTED FLUOROPOLYMER MEDICAL DEVICE SUPPLIERS	250
TABLE 104 MISCELLANEOUS RESINS MARKET BY MEDICAL APPLICATION, THROUGH 2020 (MILLION POUNDS)	250
TABLE 105 U.S. MISCELLANEOUS RESINS MARKET BY NONDISPOSABLE MEDICAL APPLICATION, THROUGH 2020 (MILLION POUNDS)	251
TABLE 106 U.S. MISCELLANEOUS RESINS MARKET BY DISPOSABLE MEDICAL APPLICATION, THROUGH 2020 (MILLION POUNDS)	251
TABLE 107 LEADING U.S. MEDICAL INJECTION MOLDERS (\$ MILLIONS)	255
TABLE 108 LEADING U.S. MEDICAL FILM AND SHEET MANUFACTURERS (\$ MILLIONS)	255
TABLE 109 LEADING U.S. MEDICAL BLOW MOLDERS (\$ MILLIONS)	256
TABLE 110 LEADING U.S. MEDICAL THERMOFORMERS (\$ MILLIONS)	257
TABLE 111 SELECTED TRADE NAMED PRODUCTS, TYPES OF RESINS, AND PRODUCERS USED IN MEDICAL DEVICES	259

LIST OF FIGURES

FIGURE TITLE	PAGE NO.
SUMMARY FIGURE U.S. MEDICAL PLASTICS MARKET BY RESIN, 2014-2020 (MILLION POUNDS)	6